Deflection Yoke

FIELD OF THE INVENTION

The present invention relates to a deflection yoke used for a triple-cathode ray tube (CRT) type projector, such as a projection type receiver and a projector.

BACKGROUND OF THE INVENTION

A deflection yoke deflects an electron beam emitted from an electron gun of a cathode ray tube (CRT) in order to display a screen, and includes a pair of horizontal deflecting coils and a pair of vertical deflecting coils.

Fig. 1 shows a configuration of a deflection yoke. Sub-deflection yoke 1 is provided at a rear end of main deflection yoke 2 having the horizontal deflecting coils and the vertical deflecting coils towards the electron gun. A pair of centering magnets 3 are provided on cover 4 which covers the sub-deflecting coil. The deflection yoke is fastened to CRT 6 with metallic fastening band 5 attached to the cover 4. CRT 6 has straight portion 6a towards the electron gun and substantially-conical portion 6b towards a screen surface.

Fig. 2 shows an operation of the deflection yoke. The deflection yoke is fitted on CRT 6, and forms horizontally and vertically deflecting fields that create a picture on the screen surface of CRT. In a projector, such as a projection type receiver and a projector, plural number of lens 7 (a single lens in Fig. 2) provided at the screen surface of CRT 6 expands a picture on the screen surface and projects picture 9 on screen 8.

Fig. 3 shows a distortion of the picture to be corrected by the sub-deflection yoke 1. The projector includes CRTs of three colors, red, green

and blue, which provides a color picture by having three pictures of three colors overlap on one another. In order to having the three pictures from different angles overlap without a displacement, the sub-deflecting coil 1 corrects the position of each picture and pincushion distortion shown in Fig. 3, thereby aligning the three color pictures.

A conventional sub-deflection yoke disclosed in Utility Model Laid-Open Publication No.63-95160 and Japanese Patent Laid-Open Publication No. 3-257742 shown in Fig. 4, and an another conventional sub-deflection yoke shown in Fig. 5 include ring-shaped ferrite core 10, horizontal sub-deflecting coil 11, and vertical sub-deflecting coil 12 which are wound toroidally on core 10. Glass tube 13 of CRT passes through the center of the core 10.

Fig. 6 shows centering magnet 3 for aligning respective centers of pictures of three colors, red, green and blue on the screen 8. The paired centering magnets 3 magnetized to have two poles, N pole and S pole, are provided at the cover 4 with fitting rib 4a provide at the cover 4 of the deflection yoke.

Fig. 7 shows one of conventional centering magnets 3. The centering magnet 3 includes knob portion 3b and knob portion 3c on ring body 3a. The centering magnet 3 is magnetized to have N pole near knob portion 3b and S pole near knob portion 3c, and produces magnetic lines 14 inside the ring body 3a.

Fig. 8 shows the conventional centering magnets 3. The centering magnet 3 can change the strength of the magnetic lines by superposing magnetic lines 14-1 generated inside ring body 3a-1 on magnetic lines 14-2 generated inside ring body 3a-2, and change the direction of the magnetic line by rotating the centering magnets.

The centering magnet disclosed in Japanese Patent Laid-open Publication No.2002-75250 is manufactured by injection-molding of plastic resin mixed with ferromagnetic material powder, and then polarizing it. The ferromagnetic material powder may include Alnico-based metal, which has a coercive force of magnetic lines varying little according to a temperature.

Fig. 9 shows a conventional horizontal deflecting coil 101 and a conventional vertical deflecting coil 102. The horizontal deflecting coil 102 has deflection section 15 where copper wires run in parallel to a tube axis of the CRT, coil-connection-wire section 16 at a rear end towards the electron gun, and coil-connection-wire section 44 at the end towards the screen surface. In coil-connection-wire sections 16 and 44, copper wires run in a direction perpendicular to the tube axis of the CRT. Since having a direction identical to the direction of the electron beam emitted, Magnetic lines produced by the coil-connection-wire sections 16 and 44 do not contribute to a deflection of the electron beam.

Fig. 10 shows a main deflecting coil and a conventional sub-deflecting coil. Sub-deflecting coil 1 provided at the rear end of the main deflecting coil towards the electron gun receives magnetic line 17 generated by the coil-connection-wire section 16 at the electron gun side of the horizontal deflecting coil. Thus, an induced voltage is generated at the sub-deflection yoke 1, thereby causing noise in the picture.

The induced voltage that is generally called "CY cross talk" is about 19V when a voltage of 1,200V is applied to the horizontal deflecting coil. The vertical deflecting coil 31 has a similar coil-connection-wire section 103. But, the voltage applied to the vertical deflecting coil does not exceed 100V, and thus does not generate magnetic lines from the vertical deflecting coil to

induce a voltage generating the noise.

When the correction of the screen position is not necessary, conventional centering magnets 3 inversely superpose the magnetic lines 14-1 generated inside the ring body 3a-1 and the magnetic lines 14-2 generated inside the ring body 3a-2 for canceling the lines, as shown in Fig. 8, thereby creating no magnetic line inside the ring body. However, it is practically difficult to completely eliminate the magnetic lines inside the ring body by superposing the centering magnets for the following reason.

Fig. 11 shows directions of resin that flows during the injection molding of the centering magnet. Fig. 12 shows the magnetic lines in the conventional centering magnet. As shown in Fig. 11, plastic resin mixed with ferromagnetic powder flows from port 18 along a direction of arrow 19 and reaches the knob portion 3c at a side opposite to the port 18. Alnico resin powder has a grain size of about 90μm and is heavier than the resin. The resin including the ferromagnetic material powder at a higher density has a smaller viscosity, thus flowing more easily. Accordingly, the ferromagnetic material powder of high density gathers at the knob portion 3c at the side opposite to the gate 18. Upon such centering magnet being polarized, the magnetic lines is strong at a portion near the knob portion 3c, as shown in Fig. 12, including a high density of the ferromagnetic material powder.

Fig. 13 and Fig. 14 show the magnetic lines created by the conventional centering magnet. Even if the knob portions 3b and 3c of the magnets having magnetic lines asymmetrical to each other as described above are placed one on another for canceling the magnetic lines, their internal magnetic lines are not completely canceled and remains a 4-pole magnetic field. Accordingly, as shown in Fig. 14, electron beam 20 passing through

the interior of the centering magnet receives force 22 due to the magnetic line 21 and thus has a spot deform into an oval shape, thus causing deterioration of a focus on the screen.

SUMMARY OF THE INVENTION

A deflection yoke is used for a cathode ray tube (CRT) including a glass tube having a screen surface and a straight portion for accommodating an electron gun. The deflection yoke includes a main deflection yoke including first and second horizontal deflecting coils and first and second vertical deflecting coils, and a sub-deflection yoke provided at a side of the main deflection yoke towards the electron gun of the CRT. The first and second horizontal deflecting coils have substantially saddle shapes and includes first and second coil-connection-wire sections and first and second horizontal deflection sections, respectively. The first and second coil-connection-wire sections are wound in a direction perpendicular to a tube axis of the CRT and along the straight portion, respectively. The first and second horizontal deflection sections are located towards the screen surface from the first and the second coil-connection-wire sections, respectively.

In the deflection yoke, magnetic lines emitted from a rear end of the horizontal deflecting coil towards the electron gun decreases. An induced voltage generated at the sub-deflection yoke accordingly decreases, and thus, a noise on a screen noise produced due to the induced voltage is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a configuration of a deflection yoke.

Fig. 2 shows an operation of the deflection yoke.

Fig. 3 shows distortion of a screen to be corrected by a sub-deflection

yoke.

Fig. 4 shows a conventional sub-deflection yoke.

Fig. 5 shows another conventional sub-deflection yoke.

Fig. 6 shows a centering magnet provided at a deflection yoke.

Fig. 7 shows a conventional centering magnet.

Fig. 8 shows a conventional centering magnet.

Fig. 9 shows a conventional horizontal deflecting coil and a conventional vertical deflecting coil.

Fig. 10 shows a conventional main deflecting coil and a conventional sub-deflecting coil.

Fig. 11 shows a direction of a flow of resin during production of a conventional centering magnet.

Fig. 12 shows magnetic lines generated by a conventional centering magnet.

Fig. 13 shows magnetic lines generated by the conventional centering magnet.

Fig. 14 shows magnetic lines generated by the conventional centering magnet.

Fig. 15 is a perspective view of a horizontal deflecting coil according to Exemplary Embodiment 1 of the present invention.

Fig. 16 shows a horizontal deflecting coil and sub-deflecting coil of Embodiment 1.

Fig. 17 is a perspective view of a horizontal deflecting coil according to Exemplary Embodiment 3 of the invention.

Fig. 18 is a plan view of the horizontal deflecting coil according to Embodiment 3.

Fig. 19 is a side view of a conventional horizontal deflecting coil.

Fig. 20 is a side view of a horizontal deflecting coil according to Embodiment 2.

Fig. 21 is a sectional view of the horizontal deflecting coil according to Embodiment 3.

Fig. 22 is a sectional view of the horizontal deflecting coil according to Embodiment 3.

Fig. 23 is a perspective view of a vertical deflecting coil according to Exemplary Embodiment 4 of the invention.

Fig. 24 is a side view of the vertical deflecting coil according to Embodiment 4.

Fig. 25A and Fig. 25B are sectional views of a deflection yoke according to Exemplary Embodiment 4 of the invention.

Fig. 26 is a sectional view of a deflection yoke according to Embodiment 4.

Fig. 27 is a sectional view of a deflection yoke.

Fig. 28 shows a ferrite core of a conventional deflection yoke.

Fig. 29 shows a ferrite core of a deflection yoke according to Embodiment 5.

Fig. 30 is a top view of a horizontal deflecting coil according to Exemplary Embodiment 6 of the invention.

Fig. 31 is a side view of the horizontal deflecting coil according to Embodiment 6.

Fig. 32 is a sectional view of the horizontal deflecting coil according to Embodiment 6.

Fig. 33 shows wiring of a deflection yoke according to Embodiment 6.

Fig. 34 is a perspective view of an insulating frame of the deflection yoke according to Embodiment 6.

Fig. 35 is a perspective view of the insulating frame of the deflection yoke according to Embodiment 6.

Fig. 36 is a perspective view of the insulating frame of the deflection yoke according to Embodiment 6.

Fig. 37 is a perspective view of the insulating frame of the deflection yoke according to Embodiment 6.

Fig. 38 is a plan view of a centering magnet of a deflection yoke according to Exemplary Embodiment 7 of the invention.

Fig. 39 is a side view of the centering magnet of the deflection yoke according to Embodiment 7.

Fig. 40 is a side view of the centering magnet of the deflection yoke according to Embodiment 7.

Fig. 41 is a plan view of the centering magnet of the deflection yoke according to Embodiment 7.

Fig. 42 shows a magnetizing yoke for magnetizing a centering magnet.

Fig. 43 shows magnetic lines generated by a conventional centering magnet.

Fig. 44 is a plan view of a centering magnet of a deflection yoke according to Exemplary Embodiment 8 of the invention.

Fig. 45 is a plan view of the centering magnet of the deflection yoke according to Embodiment 8.

Fig. 46 shows a conventional horizontal deflecting coil and a cathode ray tube (CRT).

Fig. 47 shows a horizontal deflecting coil and a CRT according to Embodiment 1.

Fig. 48A is a side view of a rear end of a conventional horizontal deflecting coil towards an electron gun.

Fig. 48B is a perspective view of the rear end of a conventional horizontal deflecting coil towards at an electron gun.

Fig. 48C is a side view of a rear end of the horizontal deflecting coil towards an electron gun according to Embodiment 2.

Fig. 48D is a perspective view of a rear end of the horizontal deflecting coil towards an electron gun according to Embodiment 2.

Fig. 48E is a side view of a rear end of another horizontal deflecting coil towards an electron gun.

Fig. 48F is a perspective view of a rear end of another horizontal deflecting coil towards an electron gun.

Fig. 48G is a side view of a rear end of the horizontal deflecting coil towards an electron gun according to Embodiment 3.

Fig. 48H is a perspective view of a rear end of the horizontal deflecting coil towards an electron gun according to Embodiment 3.

Fig. 49 shows a winding direction of a coil-connection-wire section at a rear end of the horizontal deflecting coil towards an electron gun according to Embodiment 2.

Fig. 50 shows a winding direction of a coil-connection-wire section towards an electron gun of the conventional horizontal deflecting coil.

DESCRIPTION OF THE PREFERRED EMBODIMENT

(Exemplary Embodiment 1)

Fig. 15 is a perspective view of a horizontal deflecting coil according to Exemplary Embodiment 1 of the present invention. Fig. 16 shows a main deflecting coil and a sub-deflecting coil of Embodiment 1. Fig. 46 shows an arrangement of a conventional deflecting coil and a cathode ray tube (CRT). Fig. 47 shows an arrangement of a horizontal deflecting coil and a CRT of

Embodiment 1.

In order to decrease a voltage (generally called CY cross talk) induced at the sub-deflection yoke by magnetic lines from the horizontal deflecting coil having substantially a saddle shape of a main deflecting coil, it is necessary to keep the sub-deflection yoke away from the main deflection yoke. However, increasing a space between the sub-deflection yoke and the main deflection yoke results in an increasing of the overall length of the deflection yoke. It is difficult to increase the overall length of the deflection yoke because of a physical interference with other parts, such as a velocity modulation coil mounted to a rear portion of the deflection yoke towards an electron gun. Therefore, the distance between the sub-deflection yoke and the main deflection yoke cannot be increased.

In conventional horizontal deflecting coil 15, as shown in Fig. 46, coil-connection-wire section 16 at a rear end of the coil 15 towards an electron gun has a shape (bent-up shape) bent up perpendicularly to tube axis 50 of a CRT. Thus, the coil-connection-wire section 16 emits magnetic lines backward. In the deflection yoke of Embodiment 1, as shown in Fig. 15 and Fig. 47, coil-connection-wire section 116 at an end of a horizontal deflecting coils towards an electron gun is wound in a direction along a straight portion towards the electron gun of the CRT. Since a turned-up portion of coil-connection-wire section 16 shown in Fig. 9 is eliminated, magnetic lines 17 emitted from the rear end of the horizontal deflecting coil towards the electron gun can decrease. Accordingly, the magnetic lines received by sub-deflecting coil 1 can be reduced, keeping the overall length identical to that of the conventional deflecting coil.

Regarding an amount of the CY cross talk (induced voltage), when a voltage of 1,200V is applied to a horizontal deflecting coil of the conventional

deflection yoke, the induced voltage ranges from 17V to 19V, while the induced voltage of the deflection yoke of Embodiment 1 ranges from 2V to 4V, which is lower than that of the conventional deflection yoke. Accordingly, the deflection yoke of Embodiment 1 can reduce a noise on a screen caused by the induced voltage.

(Exemplary Embodiment 2)

Fig. 49 shows coil-connection-wire section 117 at a side of a horizontal deflecting coil towards an electron gun according to Exemplary Embodiment 2 of the present invention. Fig. 50 shows coil-connection-wire section 16 at a side of a conventional deflecting coil towards an electron gun.

As shown in Fig. 50, coil-connection-wire section 16 of a conventional deflecting coil is semi-circularly wound about axis 45 parallel with a tube axis of a CRT in direction 46 so that the portion 16 is piled up in a direction of axis 35 perpendicular to the tube axis.

In the horizontal deflecting coil according to Embodiment 2, as shown in Fig. 49, coil-connection-wire section 117 is semi-circularly wound about axis 35 perpendicular to the tube axis of a CRT in direction 47 so that the portion 117 is piled up in a direction of axis 45 parallel with the tube axis.

(Exemplary Embodiment 3)

Fig. 17 is a perspective view of a pair of horizontal deflecting coils according to Exemplary Embodiment 3 of the present invention. Fig. 18 is a side view of a horizontal deflecting coil according to Embodiment 3. Fig. 9 shows a conventional horizontal deflecting coil and a conventional vertical deflecting coil. Fig. 19 is a side view of the conventional horizontal deflecting coil. Fig. 20 is a side view of a horizontal deflecting coil according

to Embodiment 2.

As shown in Fig. 9, conventional horizontal deflecting coil 15 has coil-connection-wire section 16 at a side of the coil 15 towards an electron gun. As shown in Fig. 19, the horizontal deflecting coil 15 includes effective length A contributing to deflection and overall coil length B1. The effective length is the length of a portion where copper wires of the deflection yoke are wound in parallel with a tube axis of a CRT, namely, a horizontal deflection section. Since the horizontal deflecting coil of Embodiment 3 having effective length A shown in Fig. 20 is wound in straight without projecting at coil-connection-wire section 117, the coil includes overall length B2 greater than the overall length B1 of the conventional deflection yoke.

Fig. 48A is a side view of a rear end of the conventional horizontal deflecting coil towards an electron gun. Fig. 48B is a perspective view of the rear end of the conventional horizontal deflecting coil. Fig. 48C is a side view of the rear end of the horizontal deflecting coil towards an electron gun of Embodiment 2. Fig. 48D is a perspective view of the rear end of the horizontal deflecting coil of Embodiment 2. Fig. 48E is a side view of a rear end of another horizontal deflecting coil towards an electron gun. Fig. 48F is a perspective view of the rear end of another horizontal deflecting coil. Fig. 48G is a side view of a rear end of a horizontal deflecting coil towards an electron gun of Embodiment 3. Fig. 48H is a perspective view of the rear end of the horizontal deflecting coil of Embodiment 3.

As shown in Fig. 48A and Fig. 48B, the coil-connection-wire section 16 of a conventional horizontal deflecting coil is bent at rear end 48 of its effective length towards the electron gun to form a bend-up shape. In the horizontal deflecting coil according to Embodiments 1 and 2, as shown in Fig. 48C and Fig. 48D, the total length of the horizontal deflecting coil is greater

since the coil-connection-wire section at the side towards the electron gun is piled up towards the electron gun. That is, in the deflecting coil of Embodiments 1 and 2, the rear end 48 of the effective length is located at a position identical to that of the conventional deflecting coil, but the rear end of the coil towards the electron gun extends backward.

As shown in Fig. 48E and Fig. 48F, the overall length of the coil ca be greater than the deflecting coil shown in Fig. 48C and Fig. 48D by having the exterior of the coil-connection-wire section projecting from the deflecting coil. However, even the overall length of the deflecting coil shown in Fig. 48E and Fig. 48F cannot be identical to that of the conventional deflecting coil shown in Fig. 48A and Fig. 48B. That is, since corner 49 of the rear end of the coil-connection-wire section of the horizontal deflecting coil shown in Fig. 48E and Fig. 48F is arcuate, the overall length of the coil is greater than that of the conventional coil even if the effective length of the coil is the same as that of the conventional coil.

Fig. 21 is a sectional view at line 21-21 of the horizontal deflecting coil shown in Fig. 18 according to Embodiment 3. Fig. 22 is a sectional view at line 22-22 of the horizontal deflecting coil.

As shown in Figs. 17, 18, 21, and 22, the coil-connection-wire section of the horizontal deflecting coil of Embodiment 3 has curved surface 23 facing the CRT, and curved surface 24 opposed to the surface 23, i.e., facing a vertical deflecting coil. A pair of horizontal deflecting coils face each other about plane 25. Curved surface 24 of the horizontal deflecting coil on the plane 25 towards a screen surface shown in Fig 21 has a diameter 26 identical to the diameter of the coil-connection-wire section shown in Fig. 22. Outer diameter 27 in a direction perpendicular to the plane 25 of the coil-connection-wire section of the horizontal deflecting coil shown in Fig. 22 is

greater than the outer diameter 28 of the horizontal deflecting coil shown in Fig. 21. The diameter 27 ranges from 1.05 to 1.35 times greater than the diameter 28.

This shape shown in Fig. 48G and Fig. 48H allows corner 49 of the rear end of the horizontal deflecting coil towards the electron gun to be shaped in small arc, and the rear end of the effective length of the coil extends to position 51. As a result, the overall length of the defecting coil of Embodiment 3 has the effective length identical to that of the conventional deflecting coil, while the overall length of the deflection coil is not greater than that of the conventional deflecting coil. The coil-connection-wire section of the deflecting coil at the side towards the electron can be wound in a direction along CRT according to Embodiment 3.

(Exemplary Embodiment 4)

Fig. 23 is a perspective view of a rear end of a vertical deflecting coil towards an electron gun according to Exemplary Embodiment 4 of the present invention. Fig. 24 is a side view of the vertical deflecting coil. Fig. 25A and Fig. 25B are sectional views in a radial direction of the deflection yoke of Embodiment 4. Fig. 26 is a sectional view in a longitudinal direction of the deflection yoke.

As shown in Figs. 9, 25, and 26, vertical deflecting coil 31 is mounted at an outer side of a horizontal deflecting coil 15, and is insulated from the horizontal deflecting coil 15 with insulating frame 32 shown in Fig. 25.

In order to obtain an appropriate deflecting sensitivity of the deflection yoke, the horizontal deflecting coil, the insulating frame, the vertical deflecting coil, and a ferrite core are preferably arranged to contact each other tight without a space. The horizontal deflecting coil of Embodiment 3

shown in Figs. 17 and 18 having an overall length identical to that of the conventional horizontal deflecting coil shown in Fig. 9 is combined with the conventional deflecting coil 31, as shown in Fig. 27. This arrangement creates space 33 between the horizontal deflecting coil 15 and the vertical deflecting coil 31, thus causing the sensitivity of the deflection yoke to decrease.

In a deflection yoke of Embodiment 4, as shown in Figs. 25A, 25B, and 26, a diameter of curved surface 34, on plane 35, of the vertical deflecting coil 31 facing the CRT gradually decreases from the screen surface of the CRT toward the electron gun. The diameter increases at a portion close to a rear end of the vertical deflecting coil towards the electron gun. The portion where the diameter increases is combined with portion 201 where the outer diameter of the coil-connection-wire section of the horizontal deflecting coil 15 of Embodiment 3 increases, while the insulating frame is located between the coils. This arrangement creates no excessive space between the horizontal deflecting coil 15 and the vertical deflecting coil 31, thus providing a deflection yoke having a large deflecting sensitivity.

(Exemplary Embodiment 5)

Fig. 28 shows a position and a sectional shape of ferrite core 35 of a conventional deflection yoke. Fig. 29 shows a position and a sectional shape of ferrite core 135 of a deflection yoke according to Exemplary Embodiment 5 of the present invention.

The ferrite core 135 (35) is mounted on an outer surface of vertical deflecting coil 131 (31). The core collects magnetic lines created by horizontal deflecting coil 115 (15) and magnetic lines created by vertical deflecting coil 131 (31), thus strengthening the magnetic lines inside the

deflection yoke. The inner shape of the ferrite core 135 (35) matches the outer surface of the vertical deflecting coil 131 (31).

In the conventional deflection yoke, as shown in Fig. 28, about a half of the inner surface of the ferrite core is curved. Therefore, an internal pressure distribution in the core becomes uneven between straight portion 35B and curved portion 35A when the ferrite core 35 is manufactured by pressing. Accordingly, the ferrite core 35 may be cracked or deform to have an oval shape during burning of the ferrite core, thereby having a reduced production yield. Further, the ferrite core 35 needs to have a sectional thickness enough to be prevented from having a bad yield, but this increases the material cost of ferrite.

The deflection yoke of Embodiment 5 including a horizontal deflecting coil and a vertical deflecting coil of Embodiments 3 and 4 includes ferrite core 135 having a inner diameter uniform over its entire length, as shown in Fig. 29. In the ferrite core 135, an internal pressure during press forming can be uniform without increasing the ferrite material, thus improving its productivity.

(Exemplary Embodiment 6)

Fig. 30 is a top view of a horizontal deflecting coil according to Exemplary Embodiment 6 of the present invention. Fig. 31 is a side view of the horizontal deflecting coil according to Embodiment 6. Fig. 32 is a sectional view of a deflection yoke of Embodiment 6. Fig. 33 is an explanatory diagram of wiring according to Embodiment 6. Figs. 34, 35, and 36 are perspective views of an insulating frame according to Embodiment 6.

As shown in Figs. 30 and 31, horizontal deflecting coil 15 has winding-

start wire 36 and winding-end wire 37. It is necessary to insulate the winding start wire 36 led out toward an outer periphery of the coil so that the wire 36 does not contact a wire or coil having a potential different from that of the winding-start wire 36.

As shown in Fig. 32, the horizontal deflecting coil 15 of the deflection yoke of Embodiment 6 is partitioned by the insulating frame 32 from the vertical deflecting coil 31. The insulating frame 32 has cartridge portion 38 passing the winding-start wire 36 of the horizontal deflecting coil 15 through the portion 38. As shown in Fig. 33, the wiring-start wire 36 of the horizontal deflecting coil 15 passes through the cartridge portion 38 for wiring.

As shown in Figs. 35 and 36, the cartridge portion 38 is formed by combining separated insulating frames 32. As shown in Fig. 34, the cartridge portion 38 has recess 39 provided therein. As shown in Fig. 33, the winding-start wire 36 is led into the cartridge portion 38 through the recess 39, and is then led out to the deflection yoke towards an electron gun.

The cartridge portion 38 and the recess 39, as shown in Figs. 35 and 36, can be formed by combining a wall having an L-shape and a wall having an I-shape. The cartridge portion 38 and the recess 39, as shown in Fig. 37, may be formed by combining walls each having a squared U-shape.

(Exemplary Embodiment 7)

Fig. 38 is a plan view of a centering magnet of a deflection yoke according to Exemplary Embodiment 7 of the present invention. Fig. 39 is a side view of the centering magnet of Embodiment 7. Fig. 40 is a side view of the centering magnet having a knob portion cut off according to Embodiment 7. Fig. 41 is a plan view of the centering magnet of Embodiment 7.

As shown in Fig. 7, the centering magnet includes a ring body 3a having an inner diameter of about 31mm to 33mm and an outer diameter of about 37mm to 42mm. The magnet further includes knob portions 3b and 3c provided at positions of the ring body 3a, and each of the portions 3d and 3c have a width of about 4mm to 10mm and a length of about 5mm to 20mm.

The centering magnet having a port 18 for resin molding at the end of knob portion 3b and is formed by injection molding with resin poured into the port 18. The thickness of the centering magnet ranges from about 1mm to 1.5mm, and the resin used for molding is plastic resin, such as nylon mixed with 10% to 20% of ferromagnetic powders, such as Alnico.

While the plastic resin mixed with 10% of the Alnico powders is subjected to injection molding, a portion having a high mixing percentage of the Alnico powder has a small viscosity since a grain diameter of the Alnico powder is large, 90μm. Therefore, knob portion 3c, which is opposite to port 18, of a conventional centering magnet is filled with a portion of the resin having a high density of the Alnico power during the injection molding. Upon being magnetized to have two poles, N pole and S pole, by polarizing yoke 40, as shown in Fig. 42, such molded body is magnetized a lot near knob portion 3c, which is opposite to port 18. This magnetizing makes magnetic lines inside the ring body 3a not symmetrical near the N pole and the S pole, as shown in Fig. 43.

In the centering magnet of the deflection yoke of Embodiment 7, knob portion 203c opposite to port 18 is previously formed longer by about 15mm than the knob portion 3b, as shown in Fig. 38, and the knob portion 203 has a thin portion 41 provided therein.

The thickness of the thin portion 41 may range from one half to two thirds of the thickness of the centering magnet so that the knob portion 3c

can be easily cut off after the molding. End portion 42-a containing ferromagnetic powder at the high density is separated at the thin portion 41, as shown in Fig. 41, thus allowing the centering magnet to be magnetized to have symmetrical magnetic lines inside the ring body 3a, as shown in Fig. 7.

(Exemplary Embodiment 8)

Fig. 44 is a plan view of a centering magnet of a deflection yoke according to Exemplary Embodiment 8 of the present invention.

A density of ferromagnetic material is the most uneven at port 18 and knob portion 3c provided at a side opposite to the port, while a portion of knob portion 3b including port 18 has a lower density of the ferromagnetic material than the density at the knob portion 3c. The knob portion 3b having the low density causes magnetic lines to become asymmetrical.

In the centering magnet of the deflection yoke of Embodiment 7, as shown in Fig. 44, port 18 and knob portion 203c at the side opposite to the port are previously formed longer by about 15mm, and knob portion 203c has a thin portion 41 provided therein. Further, a portion of knob portion 203b including port 18 is formed longer by about 15mm than the conventional knob portion and has a thin portion 43 provided therein.

The thickness of thin portions 41 and 43 may range from one half to two thirds of the thickness of the centering magnet so that the knob portions 203b and 203c can be easily cut off after molding. Thus, as shown in Fig. 45, end portion 42-a containing ferromagnetic powder at a high density and end portion 42-b containing ferromagnetic powder at a low density can be separated from the centering magnet. Then, the centering magnet is magnetized to generate the magnetic lines inside the ring body 3a. The magnetic lines are symmetrical, as shown in Fig. 7.